IV. *A Description of the Mammary Organs of the Kangaroo. By John Morgan, Esq., F.L.S.*

Read April 15, *and May* 6, 1828.

THE development and growth of the fœtus in marsupial animals has long afforded an interesting subject of inquiry for the researches of the physiologist; yet, notwithstanding the numerous opportunities for observation supplied by the domestication of the most interesting of these animals, namely, the Kangaroo, it is to be regretted that hardly any information has of late years been obtained upon this important branch of natural science; for although we are acquainted with a few insulated facts relative to this subject, yet we are at present left in total ignorance respecting the principal object of our researches. We know little or nothing of the nature of those changes which must necessarily take place in the young while remaining in the uterus, or of the mode by which it is conveyed from that part to the teat: and dissection has hitherto afforded us no satisfactory information relative to the peculiarity of structure, which we may reasonably expect to find in those organs, by which the mother is enabled to impart nourishment to the fœtus, either while remaining in the womb, or afterwards, when attached to the nipple within the pouch. With the view, therefore, of affording assistance to those future inquirers, whose time may be devoted to the study of this particular subject, and whose opportunity for observation may be greater than my own, I am induced

induced to present to this Society a short account of an examination which I have recently made of the female Kangaroo, both in the virgin and in the impregnated state; with the hope that the result of my dissection, which has enabled me to establish a few hitherto unknown facts, may tend to throw some further light on the physiology of generation in marsupial animals.

In the beginning of October last I received for dissection the body of a young female Kangaroo in a virgin state. On opening the pouch of this animal, I found the whole of the interior lubricated by a secretion of a reddish-brown colour, somewhat viscid in its consistence, and of a faint and peculiar odour. This condition of parts I have always observed to exist in these animals during the periods at which the pouch remains unoccupied by the young; the secretion being very much diminished, or altogether suspended, at the time the young animal is lodged within the part.

On slitting open the fore-part of the pouch and exposing its interior, I was surprised to find that two nipples only were developed, one on each side (*tab.* 2. *f.* 1. *a.*), and that immediately beneath each of these a minute circular aperture, resembling in appearance the mouth of a follicle, marked the situation in which we usually find the two additional teats in the impregnated and adult animal (*tab.* 2. *f.* 1. *b.*). This circumstance led me to examine more particularly the structure of the mammary glands and parts immediately connected with them, which, having been carefully removed from the body, presented upon dissection the following appearances.

The substance which appeared to form the mammary gland was of a circular form, somewhat flattened, possessed of a considerable degree of vascularity, and lobulated upon its external surface,

surface, and closely confined by cellular connections to the skin of the pouch (*tab. 2. f. 2. a.*). To the upper and outward part of this structure a second glandular substance of smaller size was firmly attached by dense cellular membrane, appearing of a more loose and delicate texture, and possessing less vascularity than the former; of a yellowish-brown colour, and of an oblong and compressed shape (*tab. 2. f. 2. b.*). From the interior of this second gland a number of white membranous bands resembling ducts passed to the extremity of the teat; and I could discover no further connection, than that afforded by cellular membrane, between the larger glandular substance and the smaller; the teat and the lesser gland, which I have just mentioned, appearing to form a distinct and separate mammary organ. As far, therefore, as my dissections had yet gone, the larger gland appeared altogether unconnected with any structure by which its secretions might be rendered subservient to the purposes of furnishing nutrition to the young. Believing, however, that this structure must be in some way or other connected with the formation or functions of those teats which had not yet been developed, I proceeded to examine whether any and what connection might exist between these large and obviously important glands, and the follicular openings I have already described as occupying the situation of the future teats.

On passing a small probe through one of these openings, I found that the instrument entered a cavity about three-fourths of an inch in length; and on carefully dissecting away the surrounding portions of the gland, it appeared that this cavity was formed by a narrow, membranous, cylindrical canal, which was imbedded in the gland, and extended nearly throughout its whole diameter (*tab. 2. f. 2. c.*). The connections between this membranous tube and the gland were loose and easily broken down, except at the furthest extremity from the aperture,

ture, at which part the two structures were inseparably united. On making a section of the tube, I found that its cavity was nearly half filled with a secretion precisely resembling that already described as lubricating the interior of the pouch, and that its internal surface was formed by a reflection of cuticle continued from the surface of the pouch through the aperture by which it opened into that part.

At the furthest extremity of the canal, and at the part already described as connected firmly with the gland itself, its termination was formed by a rounded papilla, which projected into its interior, resembling in miniature the extremity of the future teat in the adult. On making a section of the papilla, this resemblance was still further increased by the exposure of numerous minute vessels, which presented very much the appearance of lactiferous tubes, and which passed directly from the expanded base of the papillary projection to its extremity (*tab.* 2. *f.* 2. *d.*). By an examination of the extremity of the papilla through a lens, the similarity between that part and the teat of the adult was strikingly shown. From these circumstances, I considered that the identity of this structure with the future teat was rendered more than probable; and it occurred to me, that the only mode by which a development of the organ could take place, must consist in the complete eversion of the canal, and the consequent protrusion of its previously imbedded and papillary extremity.

The canal on the opposite side had not yet been opened: with a view, therefore, of producing an artificial eversion by mechanical means, I made pressure upon that point of the gland, which I knew from previous dissection to be closely connected with the papillary extremity of the tube, and succeeded at length in completely everting (through the opening already mentioned) the whole of the canal, from one extremity

to

to the other, producing a perfect teat in miniature, in the exact situation at which it is found in the adult impregnated animal (*tab.* 3. *f.* 1. *a.*).

I do not mean to infer from this, that pressure upon this part constitutes the means employed by nature for the development of the teat; but I mention this experiment to prove the possibility of eversion without necessary laceration of the part. The natural process by which this change is effected I have had no opportunity of ascertaining; yet in the absence of positive proof, the collateral evidence that such a change must take place seems to me too strong to admit of doubt. The complete absence of the third and fourth teats in the young female, and the exact correspondence between the situation of the openings of these canals, and the spot to which these supernumerary teats are always found attached, together with the exact miniature resemblance to those structures, which an artificial development produces; and, above all, the total want of any other structures connected with these parts, by which the production of the other teats can be in any way accounted for,—these combined circumstances afford evidence which, even unsupported by any other facts, must, I think, be allowed as confirming the correctness of my views upon this subject.

I have lately examined a young Kangaroo, preserved in the Museum of the Royal College of Surgeons, and which had but a few days only been received into the pouch (*tab.* 3. *f.* 2.). On comparing the extremely minute orifice which forms the mouth of the animal at this early period, with the teats of adult females during the time of suckling (*tab.* 3. *f.* 3.), it seems impossible, from the great size of these parts, that their comparatively enormous extremities should be received within so small an aperture as that afforded by the minute opening between the lips of the young at this early state of its exist-

ence; but this aperture, minute as it appeared, exactly corresponded with the extremity of the teat I have before referred to as having been artificially everted; and further examinations of various living Kangaroos, at different periods of gestation, furnished proof that it is to this lower elongated teat, and not to either of the upper nipples (which were found perfectly developed in the pouch of the unimpregnated Kangaroo), that the young are invariably attached; and from the period the young are first received into the pouch, to the time at which they become separated from the teat, the two superior nipples, and the smaller mammary glands attached to them, perform no functions which can apparently be connected with the process of preparing a nutritious fluid for their support. It is also found, that the size and condition of the true teat are constantly changing, in proportion to the growth of the young to which it gives attachment; that as the young animal increases in size, the teat enlarges; and this structure, —which in the unimpregnated state will measure barely half an inch, and which at the time the young is first attached to it does not exceed the size of that which I had artificially everted,—before the young has left the pouch, becomes enlarged and elongated to the extent of nearly six inches. The upper teats, however, remain in nearly the same condition as regards their relative size and form throughout every period of gestation.

Repeated recent examinations of the living animal have also proved, that the lower teats, which for distinction I may term marsupial, invariably diminish, when the young animal has ceased to suckle, to a smaller size than even that which I had artificially produced by eversion; but that, after being once developed by protrusion from their original situation in the substance of the gland, they never again recede to their former condition,

condition, but constitute permanent marsupial teats throughout the rest of life.

If a change in any way analogous to this extraordinary development of the teat in the Kangaroo should be found to occur in other animals possessing marsupial bones, it is possible that this circumstance may have given rise to the difficulty which Meckel and other comparative anatomists (unacquainted with this peculiarity) have met with in their endeavours to detect the perfect teat in the *Ornithorhynchus*, upon the supposition that young females only had been examined; since we are informed that the mammary gland only has been discovered, while the existence of a developed and perfect teat connected with that gland has escaped detection. Not having had an opportunity of examining that animal myself, I merely offer this as a matter of conjecture.

With these details of the result of my dissection of the mammary organs and pouch of the unimpregnated animal, I shall next point out the differences in the structure of those parts, which I afterwards met with in the dissection of an adult female Kangaroo, which was at the time of its death suckling a young one nearly sufficiently grown to leave the pouch. As I had in this case an opportunity of examining not only the organs to which I have referred, but also other structures connected with the functions of those parts, I shall describe their different appearances as they presented themselves on examination, including the anatomical peculiarities of the pouch, the marsupial bones, and the muscles connected with these and other important organs.

I must not, however, omit to express my gratitude to the Zoological Society, for the opportunity which was afforded me upon this occasion of continuing my investigation; having been most liberally furnished from this source with the subject for

making those dissections of which I have now to detail the results.

Commencing the dissection upon the superficial covering of the abdomen, and having removed the common integuments of that part, it will be found, that a layer of panniculus carnosus of extraordinary strength and thickness is spread over the whole of the anterior and lateral parts of the abdominal parietes, connected closely by dense cellular membrane to the subjacent abdominal muscles, except at the part where the pouch is interposed between them; here it is in like manner connected to the anterior surface of the pouch itself. The fibres of this muscle are arranged in a double order, an indistinct layer passing transversely, the stronger and more numerous passing in a perpendicular direction from the thorax to the lower part of the abdomen, surrounding in their descent the mouth of the pouch, to which they form a sphincter, and terminating by sending off a narrow slip over the fore-part of the pubis, to be attached to the sphincter muscle of the vagina. The action of this part of the muscle, therefore, would operate in drawing the external opening of the vagina forwards and upwards over the symphisis pubis, and would thus approximate the external organs of generation to the mouth of the pouch (*tab.* 4. *f. a.*).

Whether this approximation takes place in the living animal at the time the young is removed from the cloaca to the nipple has not yet been clearly ascertained; but if such were proved to be the case, it is obvious that the action of these descending muscular fibres must be mainly instrumental in bringing these parts more nearly together.

The panniculus carnosus being entirely removed, the structure and connections of the pouch were clearly exhibited. The bag is simply formed of a fold or duplicature of the common integument, which, as already stated, is attached before to the panniculus

panniculus carnosus, posteriorly, and above to the tendon of the external oblique muscle of the abdomen, while the lower and lateral parts of the bag are attached to the mammary gland by the medium of its connection with the teat, and to a muscle of the gland by cellular tissue. This muscle of the mammary gland, which has not hitherto been clearly or correctly described, is situated immediately above the brim of the pelvis, lying upon the external oblique muscle of the abdomen. It is of a triangular shape, and is attached by a narrow origin to the back part of the pelvis, from which point it passes transversely round the lower part of the belly. In its course it expands, and afterwards divides into two layers, an anterior and a posterior; between these the mammary gland is inclosed; after which the fibres of the muscle are continued onwards, and passing forward, join with those of its fellow on the opposite side. The pair of muscles, therefore, completely encircle the lower part of the abdomen, inclosing and enveloping between their fibres the mammary gland on each side (*tab. 5. f. a.*). Neither these muscles nor the marsupial bones belong properly to the pouch; since the whole of the pouch may be removed from the abdominal muscles without disturbing in the slightest degree either the muscles I have just described, the glands themselves, or the marsupial bones and parts connected with them; the pouch being, as I have already stated, nothing more than a fold or duplicature of the skin, covered anteriorly by panniculus carnosus and common integument, and connected only by cellular tissue to the abdominal parietes.

The real use of the marsupial bones has not hitherto, I believe, been clearly explained; nor have I been able to meet with any accurate anatomical description of these parts and their surrounding connections: I consider it therefore necessary, before I state

I state my own views respecting their physiology, to offer a short account of their anatomical structure.

The marsupial bones in the female Kangaroo are about three inches in length, long and narrow in shape, and incurvated in form, compressed laterally, presenting a rounded concave edge anteriorly, the posterior edge convex and sharp; the inferior extremity or base, by which it is attached to the side of the symphisis pubis, is enlarged to form an articular surface for its connection with that part. The superior extremity, which gives attachment merely to tendon and muscle, tapering to a flattened obtuse termination. The bones are placed with their rounded concave edges facing forwards, their bases being in contact, and their superior pointed extremities being separated to the extent of from three to four inches. They are confined in this situation partly by ligament and partly by their muscular attachments. By a capsular ligament they are bound to the symphisis pubis; and by triangular ligaments, the lower fourth of their posterior convex edges is connected with the body of that bone (*tab.* 7. *f. a.*).

The muscles attached to these bones are as follows: first, the tendon of the external oblique muscle of the abdomen closely covers, and is more or less connected with, these bones throughout their whole extent, and by the action of this muscle the bones are brought nearer together. The abdomen of the Kangaroo is supplied with four recti muscles, an anterior and a posterior on each side. The posterior and broader muscle is inserted into the base of the marsupial bone (*tab.* 7. *f. b.*); the anterior or smaller muscle is inserted by a round tendon into the superior extremity of the bone: this tendon extends through the centre of the muscle, the fibres of which are continued to the point of its insertion in a double penniform order (*tab.* 6. *f. a.*).

On the outer side of this tendon the muscular fibres terminate at

at the point of its insertion; while those which are attached to the inner side of the tendon are continuous with another layer of muscular fibre, which arises from the whole extent of the concave anterior surface of the bone, from its superior extremity to its base, passing transversely inwards, to be inserted into the posterior surface of the tendon of the external oblique muscle, along the linea alba. This transverse muscle may be considered as part of the anterior rectus, with which it is continuous, and has no connection with its fellow on the opposite side, except by the intervention of the tendon of the two oblique abdominal muscles; since a tendinous septum, behind the linea alba, is interposed between the points of their insertion.

We are however informed, in an account of the anatomy of these parts published in the *Philosophical Transactions* by Sir Everard Home, in the year 1795, that a transverse and continuous layer of muscle is stretched between the two bones,—an arrangement of structure which I have not been fortunate enough to meet with in my dissections of these parts. And we are further assured, that this transverse muscle actually performs the office of a sling, by which the mamma is supported.

I confess that I am at a loss to account for the cause which has given rise to this mistake in the dissection of a recent subject; more particularly as that dissection was made by an individual whose character as a comparative anatomist has been held in high estimation. The author may possibly have met with a singular variety of formation in the animal which was submitted to his inspection, and which may account for the different results of our dissections; but I consider it almost impossible that he can have met with so great a deviation from the natural form and structure of this part, as to justify him in ascribing to these muscles the use he has assigned to them: for their use is obviously that of moving the superior extremities

of

of the marsupial bones towards each other; and being situated immediately behind the mammæ, they are altogether prevented by that circumstance from affording the slightest support to the mamma itself.

The marsupial bones thus confined in their situation by ligaments, and by the surrounding muscles in which they lie imbedded, afford from their situation a firm inferior support to the abdominal viscera, and form an unyielding partition between those parts and the pouch. But another important purpose seems to be answered by these structures. I have already described two muscles, which are formed for the purpose of compressing the mammary gland; and I have mentioned also the continuity of these two muscles by the interlacement of their fibres over the linea alba (*tab. 5. f. a.*). These muscles form from their situation a sort of girdle around the belly immediately above the pelvis, and would necessarily, when put into action, press the mammary glands against the comparatively yielding sheet of abdominal muscles which lies behind them, were it not for the marsupial bones, which prevent any compression of the lower part of the abdomen from the action of the mammary muscle, and at the same time receive the glands themselves upon their concave anterior edges. These edges afford a hard and solid point of resistance, against which the glands are pressed; and their secretions are thus forced through their excretory ducts towards the teats.

It appears to me probable, that in the Kangaroo, the loose connection of the mammary gland to the subjacent textures may allow of its being drawn backwards and forwards across the edge of the marsupial bone, by the alternate contraction and relaxation of its proper muscle, and thus the process of emptying its ducts by pressure may be considerably facilitated.

That Nature in other cases avails herself of the agency of muscular

muscular contraction for the purpose of compressing a gland, and thereby emptying its ducts of their contents, we have already sufficient proof. The venom of the Rattle-snake is forced through its perforated fang by a muscular apparatus connected with the secreting organs; and the musk gland of the Crocodile has been shown by my friend Mr. Bell* to possess a muscular investment, obviously destined to perform the same functions as I have attributed to a similar peculiarity of structure in the Kangaroo.

The use of a forcible compression of the mammary gland of the Kangaroo, exerted at the will of the mother for the purpose of ejecting its secretion, will be rendered apparent by an examination of the young at the time it is first attached to the nipple; for the imperfect state of organization in which we find the young of marsupial animals at the time they first make their appearance in the pouch,—more particularly evinced by the state of the mouth and its appendages,—compared with the more mature development of the same parts in the young of other mammalia, renders some provision necessary, by which nutrition should be imparted solely by the agency of the mother; and this provision is clearly afforded by the injection of the milk into the mouth by the means I have already mentioned, instead of that fluid being extracted by the suction of the young, as in the case of other mammiferous animals. That the secretion of the marsupial mammary gland may be ejected by pressure made upon the part, is rendered probable not only by the existence of a compressing muscle, but also by the structure of the marsupial teat and its proper investments, which I shall next describe. I wish it, however, to be clearly understood, that in the description which I am now giving of the anatomy of these parts, I refer to the mammary organ in the full-grown Kan-

* *Phil. Trans.* 1827, *p.* 132. *t.* 11.

garoo, when loaded with its secretions, and at a time when the young within the pouch was several months old; for, as I have before stated, the condition of these parts is constantly changing at different periods of gestation. At the particular period, however, which I have mentioned, as referring to the animal under consideration, the following appearances were presented.

On removing the muscle which enveloped the mamma, that part was found, as in the virgin animal, to be composed of two distinct glandular substances, bearing nearly the same relative proportions as in the former instance (*tab.* 8. *f.* 1.). In form, however, they were somewhat altered; for the larger gland had now changed from a circular to an oval shape, it was of a purplish colour, and possessed of a very high degree of vascularity. The marsupial teat was now found attached to its inner side. In the former instance, when mentioning the dissection of the virgin animal, it will be remembered, that this gland was described as closely confined to the skin of the pouch immediately behind the follicular openings, which led to a central canal in its interior; whereas, it was now found that its cellular connections were comparatively loose, and that its attachment to that part of the integuments, to which it formerly closely adhered, was now formed by the medium of its excretory ducts, which, inclosed within their proper sheath, were collected together and disposed in the form of a fasciculus or cord passing from the inner margin of the gland to the marsupial teat.

All remains of the follicular apertures in the pouch had disappeared, the gland was removed from its former situation, and its excretory ducts, formed into a plexus or fasciculated cord, were continued from the gland to the true marsupial teat, exactly through that part of the integuments of the pouch, which, in the virgin animal, was occupied by the aperture I have before alluded to.

The

The smaller gland appeared somewhat more vascular than that which I had before examined in the younger animal, and was connected by a similar arrangement of ducts with the upper and smaller nipple (*tab.* 8. *f.* 1. *a.*). From the larger marsupial mammary gland about twenty excretory ducts are sent off, these being closely connected together by reticular membrane, and inclosed in a sheath, (forming, as I have stated, a sort of fasciculus or cord,) are continued to their termination at the extremity of the nipple in nearly a straight line. In its course from the gland, this plexus of ducts first passes between the skin of the pouch and the abdominal muscles as far as the base of the marsupial teat, at which part it enters the teat, and is continued to its extremity, where each duct terminates by a separate opening. A sheath of longitudinal muscular fibres closely envelops this fasciculus of ducts throughout its whole extent; and at the point of junction with the gland, these muscular fibres are expanded over the surface of that organ, to nearly the whole of which they are attached by cellular connections (*tab.* 8. *f.* 1. *b.*).

The use of this muscle is to draw up and shorten the teat, when its ducts are emptied, or to compress that part when this retraction is prevented by a distended state of its vessels: whenever, therefore, the lactiferous tubes are filled by injection from the mammary gland, and the part becomes distended, this muscle considerably facilitates the transmission of the secreted fluid through the teat by compressing the ducts, and thus squeezing their contents towards the extremity of the nipple. Thus the lactiferous tubes within the mammary gland, and the excretory vessels which are sent off from those tubes through the teat, are furnished by Nature with precisely the same muscular apparatus for the ejection of their contents.

The compressing muscle of the teat, however, is only capable of performing this office when assisted by that of the gland; for

until by the contraction of the latter the ducts become distended, no resistance is offered in the direction of the longitudinal fibres of the muscle which incloses them; and we consequently find, that when the marsupial teat is empty and flaccid, its contraction (which can be easily felt in the living animal) diminishes the part to one-fourth of its size when in the distended state; for when empty the teat is drawn up, and the skin which covers it becomes loose and corrugated. When, however, the teat is distended, the contraction of the muscle would of course tend to produce a considerable degree of pressure upon the vessels which it incloses.

Having thus endeavoured to prove, that a forcible compression of the gland and teat is necessarily occasioned by the contraction of their surrounding muscular investments, and that by this compression the excretory vessels must be emptied of their contents; having also mentioned the probable necessity for this provision in the mother, as indicated by the condition of the young, I shall now conclude my account of the mammary organs by describing some other structures which enter into the composition of the teat and gland. It will be necessary, however, that I should first notice a peculiar and singular change in these structures, which I have observed to occur in the living animal, and which is, I conceive, in a great measure dependent upon the existence and functions of other parts which yet remain undescribed.

The change to which I allude consists in an extraordinary distention or enlargement of the marsupial mammary gland and teat, which is constantly found to take place during the time the young is engaged in the act of sucking. This distention is considerably greater than any which could possibly arise from the most forcible injection of the lactiferous tubes; and I have clearly ascertained, by repeated and careful examinations of the

the pouch in the living animal, that it is produced at will by the mother, apparently for the purpose of preparing the parts for the more ready transmission of milk to the young. On these occasions the gland and teat will be found of nearly double the size which a full injectment of the ducts is capable of producing. The cause of this additional enlargement however was, as I conceive, explained by an examination of the vascular system in the parts alluded to; for by continuing the dissection, and carefully removing the compressing muscles of the gland and teat, it was found that, from the number and size of the veins, any obstruction to the circulation of blood through these vessels would in itself be sufficient to occasion a degree of distention by which the extraordinary increase of size in these parts might be adequately accounted for. The distribution of the veins in the marsupial gland is not characterized by any remarkable appearance as regards their course; from their immense number, however, the whole surface of the gland presents when closely examined a reticulated congeries of vessels, which, with those of the interior, unite into larger trunks, the greater number of which terminate on the outer convex surface of the gland in a single vessel (*tab.* 8. *f.* 2. *a.*), which passes first between the two layers of the proper muscle of the mammæ, afterwards descends upon the tendon of the external oblique, and ultimately empties itself into the external iliac vein. This vessel, however, conveys only a part of the blood from the marsupial gland towards the heart, since another venous trunk, issuing from the inner margin of the gland, descends in a similar manner to the same termination, namely, to the iliac vessels. This vein conveys not only the remaining portion of blood from the gland, but also the whole of that which returns from the marsupial teat (*tab.* 8. *f.* 2. *b.*).

Venous circulation, carried on through vessels thus situated, must necessarily meet with obstruction from the action of the compressing

compressing muscles through which they pass; and it therefore appears more than probable, that whenever the gland is squeezed against the marsupial bone, a greater or less degree of venous congestion, and consequently distention of the part, must be occasioned by the pressure which is made upon the veins through which the blood is returned. That a loaded state of the veins, together with an injection of the lactiferous tubes, will occasion in the marsupial gland of the dead animal an increase of size corresponding to that which is found to exist in the parts during life, I have proved by the experiment of throwing an injection of quicksilver into the ducts, and one of water into the blood-vessels, by which process the exact natural form and capacity of the mamma, as it exists during the period of suckling, is artificially produced. Thus the extraordinary distention of the marsupial mammary gland to which I have alluded, is, I conceive, produced in a great measure by an enlargement of the vessels which naturally exist in the part; but the extraordinary distention of the nipple is partly occasioned by a change which takes place in a peculiar vascular structure which enters into the composition of the teat, and which is formed apparently for this particular purpose: for we find immediately beneath the compressing muscle of the teat, that a layer of loose reticular membrane, forming a bed for a congeries of tortuous veins, is interposed between that structure and the central fasciculus of excretory ducts. The vascular sheath by which this central fasciculus is thus inclosed, consists principally of a dense plexus of veins, which are extremely large and numerous in proportion to the size and number of the arteries which accompany them (*tab.* 8. *f.* 2. *c.*). So great is the vascularity of this sheath, that in many parts it nearly resembles in appearance the corpus spongiosum of the penis, and like that part is capable of considerable distention, either by an obstruction to its venous circulation in the

the living animal, or by artificial injection after death. The existence of this structure throughout the whole length of the marsupial teat, will at once account for the extraordinary enlargement of that part before alluded to; for since the veins of the plexus empty themselves into the mammary vessels, an obstruction to the circulation of blood through their main trunks must necessarily operate in producing a congestive swelling both of the marsupial gland and of the teat. I conceive, therefore, that the distention of the nipple at the period of suckling, is occasioned not only by the injection of its excretory ducts, but also by the state of venous congestion which must necessarily occur at that time in the vascular covering which surrounds those ducts, occasioned by the pressure of the muscles of the marsupial gland upon the trunks of the veins returning blood from the part. Thus it will be understood, that the teat is composed of four distinct structures; first, of the common integuments: secondly, of its compressing muscle; thirdly, of the vascular plexus, which I have just mentioned; and lastly, of its central fasciculus of lactiferous tubes.

I have injected the excretory ducts of the gland with quicksilver from the extremity of the nipple to their extreme branches, and have met with no unusual appearance either as regards their course or distribution. They are about twenty in number, and terminate by separate openings at the extremity of the nipple. The appearance which they present when injected is accurately shown (*tab.* 8. *f.* 2. *d.*). They are bound together by a delicate tissue of reticular membrane, and are continued a short way into the substance of the gland before they separate. Throughout their whole course they are possessed of a very considerable degree of elasticity.

Having thus detailed the anatomical peculiarities which I have met with in the marsupial gland and teat, and having endeavoured

deavoured to assign a cause for the changes which I have met with in these parts in the living animal, it now merely remains for me to describe the appearances which presented themselves in the dissection of the smaller gland and teat.

This gland, as I have before stated, is not possessed of any great degree of vascularity. Its coverings, as well as those of the smaller teat, are very similar to the investments of the larger organ, but considerably less distinct. From its close connection with the marsupial gland, it derives in common with that organ a strong covering from the compressing muscle of the mamma; but the compressing muscle of the teat consists of a few scattered fibres only, which cannot without difficulty be distinguished from the surrounding cellular membrane, beneath which a very small and delicate vascular plexus is situated, extending, as in the larger marsupial teat, from the extremity of the nipple to its base, forming a close investment around the excretory ducts of the gland (*tab.* 8. *f.* 1. *c.*). These ducts are extremely minute in size, from fifteen to twenty in number, and closely resemble in their course and distribution through the gland, the larger ducts of the marsupial teat (*tab.* 8. *f.* 1. *a.*). The veins and arteries of the smaller are closely connected with those of the larger gland; and the two organs so nearly resemble each other in their anatomical characters, that they can only be said to differ in size and in vascularity.

With regard, however, to the use of the smaller gland and teat, this is a point upon which I am unable to arrive at any satisfactory conclusion. I have never found the slightest alteration in the condition of these parts during any of the different periods of gestation. The young animal is never attached to the smaller nipple during the first period of its existence in the pouch; nor have I ever been able to ascertain (although I have taken much trouble to investigate this subject) that at any subsequent

sequent period the more perfectly developed young animal has ever been known to extract any nutritive fluid from the upper and smaller teat. Unless therefore I have recourse to analogy, and compare the smaller gland and teat with the supernumerary mammæ and nipples which we find in other animals, any theory which I could suggest relative to their use must be founded entirely upon conjecture.

I have now concluded my anatomical description of the mammary organs of the Kangaroo. At the time I was engaged in the dissection of these organs, I was not aware that a description had already been published of one of the structures described in this paper,—I allude to the compressing muscle of the teat,—the existence of which has been noticed by M. Geoffroy St. Hilaire, in the *Annales des Sciences* for 1826, who has correctly described its use; although, from the state in which he appears to have received a small portion only of this particular part, his dissection does not seem to have afforded him an opportunity of tracing the exact extent and attachment of the muscle.

With the exception, however, of the published account of M. Geoffroy St. Hilaire's dissection of these muscular fibres, I am not aware that any former anatomist has noticed the peculiarities of structure which I have described as existing in the mammary organs of the Kangaroo. Believing, therefore, that many of the facts which I have detailed are entirely new, I have been induced to present the foregoing account of my investigation to this Society, in the hope that by making them generally known, I may be fortunate enough to draw the attention of future physiologists more particularly to this interesting branch of natural science.

The facilities which in this country are afforded to those who may be inclined to undertake a course of experimental inquiries

upon the living marsupial animal will be found sufficiently ample, and our opportunities for making anatomical examinations upon the dead subject are by no means rare. With such advantages therefore, I trust that the time is not far distant when we shall be furnished with a full and distinct account of the object of our researches; and that by a detail of connected facts, the phænomena attending the changes which occur during the fœtal life of marsupial animals will be as clearly understood as those which take place during the progress of generation in other mammiferous quadrupeds.

EXPLANATION OF THE PLATES.

TAB. II.

Fig. 1. Represents the interior of the pouch of a virgin Kangaroo, the fore part of which has been cut away to show— *a*. The upper and smaller teat. *b*. The small circular aperture occupying the situation of the future marsupial teat. A bristle has been introduced.—Page 62.

Fig. 2. A view of the mammary glands of the same pouch, shown by removing the skin, &c. from the abdominal muscles, and reversing the preparation exhibited in Fig. 1. *a*. The larger gland or true mamma cut open to expose its membranous canal. *b*. The upper and smaller gland. *c*. The unopened membranous canal shown by dissecting away its connections with the gland. *d*. The canal slit open to show its termination in a projecting papilla. *e*. A bristle passed through the canal into the pouch.—Page 63, 64. *ff*. Glands apparently belonging to the absorbent system.

TAB. III.

Fig. 1. Interior of the pouch of the virgin Kangaroo, in which the lower teat on the right side has been produced by artificially everting-- *a.* The membranous canal of the mammary gland, and projecting *b.* Its papillary termination. *c.* The follicular aperture formed by the opening of the canal, and through which the canal with its papilla is pushed and everted.—Page 65.

Fig. 2. Young Kangaroo supposed to be only a few days old, figured to show the contrast between the extremely minute aperture of the mouth at this early period, and the extremity of the marsupial teat as shown in Fig. 3. —Page 65.

Fig. 4. Represents the young animal in a more advanced state; the teat to which it was attached is shown in Fig. 5, which, it will be seen, bears a very close resemblance to that which is produced by the artificial eversion of the canal in the mamma, as shown in Fig. 1. *a. b.*

TAB. IV.

The panniculus carnosus of the Kangaroo, covering the fore part of the abdomen, as described in page 68. The muscular fibres will be seen encircling the mouth of the pouch, to which they form a sphincter, and some of the descending fibres are shown passing over the pubis to be inserted into the cloaca, *a.*

TAB. V.

This plate exhibits a view of the interior of the pouch of an adult Kangaroo at the period of suckling, together with the compressing muscle of the mamma. *a.* Compressing muscle. *b.* Marsupial teat. *c.* Upper and smaller teats.—Page 69 and 72.

TAB. VI.

a. The anterior Rectus abdominis muscle.—Page 70 and 71.

TAB. VII.

b. The posterior rectus muscle of the abdomen. *a*. The triangular ligament connecting the marsupial bone with the pelvis; the ligament has been removed on the opposite side, to show the exact form of the bone itself.—Page 70.

TAB. VIII.

Fig. 1. Represents the double mamma of the Kangaroo dissected.—Page 74. *a*. Excretory ducts of the smaller gland. *b*. Compressing muscle of the marsupial teat.—Page 75. *c*. Small plexus of vessels.

Fig. 2. A view of the blood-vessels and ducts of the true marsupial gland and teat.

a. Larger vein and artery. *b*. The smaller ditto.—Page 77 and 78.

c. Dense plexus of veins and arteries. *d*. Ducts of the gland traced to their termination.—Page 79.